Numerical analysis of the slit gusset plate damper using the finite element method

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This study introduced a Gusset Plate Damper (GPD). This damper has a small height-to-thickness ratio which causes not only out-of-plane buckling is not considered but also has a high bearing capacity of tensile-shear force and compressive-shear force. Also, economically, it is more economical compared to Steel Slit Dampers (SSDs) with high height-to-thickness ratio. In order to evaluate the performance of hysteresis of the proposed dampers, 15 laboratory samples with different dimensional ratios (height to width) and with 3 thicknesses of 15 mm, 20 mm and 30 mm as finite components were examined using Abaqus software; So that the forming of damper is reduced by reducing the dimensional ratio while increasing the bearing capacity of shear force and energy consumption. To design the Gusset Plate Dampers, optimized geometric dimensions of the hourglass shape of block slit dampers have been used with the difference that the innovative damper has twice the displacement capacity than the block slit damper. Another advantage of the gusset plate damper is the improvement of old and built structures, as well as the easier replacement of the gusset plate after applying force to the structure. In these studies, the yield mechanisms for the cross-brace have been proposed to improve the performance of the cross-braces which cause to absorbs the energy of the structure using shear yield of the plate. This proposed damper has slit gusset in the form of hourglass to create a shear-tensile or shear-compression system. The system mechanism in this damper is as metal-yield; which uses the shear yield of the plate to absorb the energy of the structure. This damper consists of: X-shaped cross-brace, plates and hourglass. These cross-braces have a high damping that acts like a fuse; Therefore, they are in the category of yield dampers. At the end of this study, we conclude that the effective hardness decreases and the effective damping increases after the damper yields and enters the inelastic zone; So that the change process takes place suddenly in small loading domains, but the change process takes place gradually from the displacement range of 20 mm onwards; effective hardness also decreases by increasing displacement. According to the damping results, if we expect a displacement of 60 mm from the damper, this expectation will be 60 to 70%, which is an acceptable damping compared to viscous dampers.

Keywords: Gusset Plate Damper, Block slit damper, Energy dissipation capacity, Primary stiffness, Secondary stiffness, Effective damping, Hysteresis diagram.